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**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**WASHINGTON D.C. 20460**

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**OFFICE OF THE ADMINISTRATOR**
**SCIENCE ADVISORY BOARD**

Honorable Marianne L. Horinko
Acting Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Clean Air Scientific Advisory Committee Review of the Agency's *National Ambient Air Monitoring Strategy*

Dear Acting Administrator Horinko:

The Clean Air Scientific Advisory Committee's (CASAC) National Ambient Air Monitoring Strategy (NAAMS or "Strategy") Subcommittee ("Subcommittee") met on July 8-9, 2003 to review the Agency's ) National Ambient Air Monitoring Strategy document in a public meeting held at the EPA facility in Research Triangle Park, NC. This was the first CASAC-related review of the draft NAAMS document. Members of the newly-formed CASAC NAAMS Subcommittee are recognized, national-level experts in one or more of the following disciplines: (a) atmospheric sciences and air quality simulation modeling; (b) health effects and exposure; (c) air quality measurement science; or (d) State or local agency experience.

## 1. Background

EPA had developed the final draft of the NAAMS document under the direction of the National Monitoring Strategy Committee (NMSC), an intergovernmental partnership comprising representatives from EPA (*i.e.*, the Office of Air Quality Planning and Standards (OAQPS), the Office of Research and Development (ORD) and Regional Offices), and State and local agencies and Tribes (who are the principal Federal grantee organizations that operate the majority of the monitoring networks). The draft NAAMS document contains technical information underlying planned revisions of the National Ambient Air Monitoring program. The Strategy proposes a restructuring of the national regulatory-based air monitoring networks — commonly referred to as National Air Monitoring Stations (NAMS), State or Local Air Monitoring Stations (SLAMS), and Photochemical Assessment Monitoring Stations (PAMS) — to accommodate emerging priorities of air programs, the public and the scientific community. Specifically, the NAAMS provides a series of proposed changes for network design and improvements, assessments of

existing networks, incorporation of new measurement and information transfer technologies, and revisions both to the current quality assurance program and the monitoring regulations. The NAAMS document is available through EPA's Ambient Monitoring Technology Information Center (AMTIC) Web site at: http://www.epa.gov/ttn/amtic/stratmem.html.

The Subcommittee had been asked to provide formal review of the following elements of the Strategy:

(a) The NCore proposal, including conceptual approach to tiered monitoring levels, recommended measurements and numbers and locations of Level 2 sites. Consideration to phasing of measurements included in Level 2 sites should be addressed based on currently available and expected emerging monitoring technologies. The Subcommittee is also requested to advise on the scope and breadth of research-grade Level 1 sites.

(b) The use of spatial analysis approaches for network design and other air program planning needs. The monitoring strategy has utilized various spatial design approaches on national and regional scales to identify areas of redundant monitoring as well as gaps requiring additional monitoring.

(c) The use of performance-based approaches for standardizing monitoring method requirements for particulate matter measurements. Performance-based approaches rely on applying data quality objectives to determine the allowable statistical uncertainties for instrument performance. This third subject area has evolved from discussions with the existing CASAC Subcommittee on Particulate Monitoring, and plays an important role in facilitating accommodation of new technologies into air monitoring networks.

## 2. CASAC NAAMS Subcommittee Review of the Agency's *National Ambient Air Monitoring Strategy* Document

The CASAC NAAMS Subcommittee would like to strongly commend EPA's OAQPS the State, Local, and Tribal (SLT) agencies involved in developing this draft strategy. It is an excellent idea to periodically review how things are done and why they are structured as they are. The idea of stepping back and looking at why we need air quality monitoring and then evaluating what needs to be measured and where is a key step to moving forward in air quality management as well as potentially providing critical information for obtaining a better understanding of air quality and health and welfare effects.

The strategy provides a very good conceptual framework for moving forward with assessing and modifying the monitoring network. The basic concepts of fewer, but more comprehensive measurement sites with an emphasis on more continuous measurements and a better balance between urban and rural sites are appropriate and important steps forward. Our view of the air pollution problem has evolved from that of local sources of one or a few pollutants causing local impacts to a more informed view that local sources produce an

increment of input to regionally transported concentrations of a variety of materials that are chemically reactive and involve both criteria and non-criteria species. Thus, the incorporation of more regional view of air pollution to help examine this aspect of the problem is a good step forward.

However, there are many operational details that need to be developed and implemented in order to achieve the goals outlined in the draft strategy. Thus, in addition to responding to the specific questions presented in the charge, the Subcommittee has reviewed the Strategy and provided comments on both the Strategy and a number of implementation issues that will need to be carefully considered in order to achieve the Strategy's stated goals. This report provides the consensus views of the Subcommittee. The comments of the individual members are provided in the appendix to this report.

The Strategy sets out a set of Objectives for the ambient air monitoring network. They are supposed to represent a complete set of objectives for the restructured monitoring network. The charge to the committee asks if all the potential uses of the output of air monitoring are adequately reflected in the Objectives.

One member of the NAAMS Subcommittee raised the issue of ecological/welfare effects and monitoring since monitoring in support of ecological/welfare effects is nonexistent in the Plan. This need for monitoring to provide protection for ecosystems and welfare effects warrants incorporation in the strategy. EPA acknowledged that the Plan intentionally ignored ecological and welfare effects due to the lack of a constituency within OAQPS. The committee requests that ecological/welfare effects be explicitly addressed and that a formal Plan be developed and submitted for review by the Subcommittee within 180 days. Since there are to be a substantial number of monitors redeployed to rural locations the focus is still on better understanding of the air quality for human health protection. The Subcommittee recommends that ecological/welfare issues be included as a part of the siting decisions for these monitoring locations.

There is currently monitoring being conducted to assess welfare effects which has not been coordinated with the NAAMS. For example, the National Acid Deposition Program (NADP) network is measuring the composition and fluxes of acid precipitation to provide the data needed to assess the impacts of acid deposition on ecosystems. It would be useful to initiate discussions with the NADP management so as to coordinate their measurements with components of the EPA ambient air monitoring such as CASTNET and IMPROVE in order to maximize the information content of the resulting data. The principles and procedures of incorporating non-NCore datasets such as NADP, satellite data and surface visibility data into the monitoring program should be explicitly considered by the Strategy.

In addition, these objectives are currently unstructured in terms of priority and the Subcommittee is concerned that when possible conflicts arise among the objectives, there is not a clear guidance as to which objectives should take precedence. There may be a lack of

consistency in the monitoring network that might diminish the effectiveness of the redeployment and the utility of the data that will result from the restructured monitoring network. It may be useful to at least separate primary and secondary objectives rather than to produce a fixed set of ordered objectives. Without some degree of prioritization, it is hard to have an effective assessment process that will examine the existing network and restructured networks in a manner that will best meet the essential monitoring objectives.

The first step in the process will be for the SLT agencies to assess the existing monitoring networks. The Strategy provides some examples of assessment processes, but there are several problems that need to be addressed. Given the regional nature of many air pollution problems, it is critical that there be a consistent approach to monitoring and comparable monitoring network performance across logically connected air shed regions. The Subcommittee strongly suggests that OAQPS develop a guidance document for network assessment that provides a solid context for the evaluation of the existing networks and of alternative designs for a revised and refined network. These guidelines have to reconcile the need for nationally consistent assessment with the regionally specific monitoring and assessment requirements.

The assessment process will need to be comprehensive. For example, the Region 5 examples given in the Draft Strategy are for a single species and are not multiple species assessment. Since multiple pollutants (ozone, $NO_x$, $SO_2$, reactive hydrocarbon compounds including some hazardous air pollutants (PAMS, HAPs), and $PM_{2.5}$) are interconnected in terms of sources, atmospheric chemistry and spatial impacts, comprehensive, multiple species monitoring will need to be emphasized in the guidance developed and provided to the SLT agencies who will have to make the final decisions with regards to network structure and operation. However, if organic species are to be measured, then it is critical that the measurement program should be integrated into an overall air quality management strategy that will actually make use of the data being collected.

The Subcommittee was specifically asked to comment on the use of spatial analysis in network design and the utilization of the resulting data. Currently, the Strategy has very little detail on the use of spatial analysis as part of the monitoring network assessment, design, or application of the resulting data. It may not be useful to put a lot more detail on spatial analysis methods into the Strategy, but the detailed discussion of these methods will be critical as part of the network assessment guidance as well as future guidance on the interpretation of the resulting network data. The Subcommittee supports the use of a number of well-established spatial analysis tools such as kriging, empirical orthogonal function analysis and related techniques, and geographical information system (GIS) approaches that can be used for these purposes. These tools can also be used in the regulatory decision-making process, such as establishing the spatial domain of non-attainment areas for the criteria pollutants.

In addition to data analysis tools for the monitoring network, there are a variety of other data sources than can be used to assist in the spatial analyses. These include satellite images and

remote sensing data that can be combined with the ground level monitoring data to provide a richer source of information that can be exploited as input to a variety of air quality decisions. At this time, there are a variety of approaches used for defining the region over which a monitor measurements apply. Again, there will be a need for clear guidance that describe the well documented spatial tools and how they can and should be applied to the interpretation of data from the monitoring network, for network assessment and design, and, eventually, for regulatory decisions.

In addition to the data obtained through NCORE, there are a variety of other data sources that can be used to assist in the spatial analyses. These include data from several satellites, surface visibility data from weather stations and other remote sensing data. These data can be combined with the ground level monitoring data from NCORE sites, to provide a richer source of information that can be exploited as input to a variety of air quality decisions.

The Subcommittee supports the conceptual framework of the National Core Network (NCORE) approach that is described in the Strategy. The Strategy suggests a three-level approach. L1 sites are high level sites at which research level instruments are deployed. L2 are multicomponent monitoring sites (L2) with sophisticated commercial instruments that provide more highly time resolved data and measure species than have been typically included in the national regulatory-based air monitoring networks, commonly referred to as National Air Monitoring Stations (NAMS) and State or Local Air Monitoring Stations (SLAMS). Finally, L3 sites will be primarily used for regulatory compliance measurements like the NAMS/SLAMS sites currently employed for real-time mapping and public communication. There are a number of issues regarding this design that the Subcommittee discussed and for which we have recommendations.

The Strategy presents this three-tiered structure as a pyramid that suggests continuous gradations in capabilities between the L3 and L2 sites and between the L2 and L1 levels. It is clear that some L3 sites will need to be equipped with more capabilities than others depending on the assessment of the measurement needs and may well approach the level of sophistication for a basic L2 site. The L2 sites can range from rather basic Speciation and/or PAMS sites through ones in which commercially available semi-continuous monitors are in operation.

The Subcommittee does agree that there is a continuing need for L1 sites where the latest in monitoring technology can be tested under realistic field conditions. Long-term operation of L1 sites at a limited number of locations could also provide critical information for improved human health studies. As the Strategy states, there is currently no funding available to develop such sites. It would be very useful to EPA and the SLT agencies to ensure that there continues to be development and testing of advanced monitoring methods and thus, OAQPS should explore ways in which at least a minimum level of L1 activities can be maintained. One possible starting point would be to augment a number of L2 sites with additional infrastructure such as additional power and shelter space such that government, industry and university researchers could easily

bring new technology to these sites for side-by-side operation against existing sophisticated commercial technology that would be in operation at the L2 sites. However, it would be valuable to establish a minimum number of permanent L1 sites to support the Strategy's objectives. Funding for these L1 sites cannot come from a decrease of other aspects (L2 and L3 sites) of the monitoring strategy. EPA should consider a more substantial level of methods development and field testing support from the Office of Research and Development (ORD), and more direct coordination between ORD and OAQPS than has been evident in recent years.

Another aspect of individual L1 sites to be considered is that they should be designed and deployed to meet a relatively limited number of objectives and that different sites may be deployed to meet different objectives. For example:

1. Methods assessment (1 to 2 sites)
2. Intercontinental transport (1-2 sites)
3. Intracontinental transport (1-2 sites)
4. Health effects (1 to 3 sites)
5. Continued evaluation of performance-based assessments (1-2 sites)
6. Specific regional issues

Each site might have two, and possibly three missions. The Subcommittee suggests that limiting the number of objectives for any specific L1 sites makes it more likely that they can be successful rather that trying to meet a broad suite of needs and not being able to adapt to the potentially conflicting requirements.

The document seems to reinforce the view that if the concentrations of gaseous criteria pollutants are low compared to the standards, then measurements can be eliminated. The Subcommittee would suggest that this is not the case given the broader need for these measurements. At this time, CO and $SO_2$ violations have generally been eliminated. The gas concentrations may no longer reach the levels of the standards, but the data provide critical information for air quality management. Clearly, good $NO_x$ measurements in ozone problem areas are critical to design and implement optimum control strategies. CO and $SO_2$ measurements can still provide useful information for examining pollutant sources and estimating atmospheric processes using atmospheric chemistry models.

In general, the problem is that the compliance monitors were designed for higher concentrations than are now typically observed and thus, more sensitive and more specific monitors are needed. If these monitors are not yet available, then an appropriate development effort should be initiated to provide such monitors in as short a time as possible. There is discussion of this approach in the document, but there is often a sense that the need for gas monitoring has very substantially diminished and does not need to be considered in the future. The Subcommittee believes that better monitors are clearly needed at both selected L3 and most L2 locations. The decision should be on an individual basis based on the network assessment and the needs for understanding the air shed behavior to provide the information needed for

appropriate air quality planning.

There is a lack of a well-articulated plan for "technology transfer" from Level 1 to Level 2 and Level 3 sites. The Strategy states that "the perspective that a clear demarcation exists between science-oriented and agency-based monitoring is counterproductive to optimizing the collective value of research and air monitoring" does not fully identify the nature of the problem. The demarcation has existed in the US monitoring programs because there are no consistent protocols and procedures to transfer high-grade science and technology coming from research to the routine monitoring performed by the state and local agencies. For example, SLT personnel are not usually amenable to new technologies unless instrumentation has been proven to be truly ready for widespread deployment.

There was an explicit charge to the Subcommittee to examine the L2 number and siting criteria. The Subcommittee identified a numerical error in Table 2 of the Strategy Summary document in that the site numbers do not add to the correct totals. The idea of 70 to 100 L2 sites appears to be reasonable. The siting is currently presented in broad terms in terms of distributions among the states and between rural and urban sites. However, this general distribution of sites also appears reasonable. The specific choices of location will be important and one aspect of these choices may be to find sites where it is possible to explicitly relate the location to health studies or other important research objectives. The EPA will shortly be awarding a grant for long-term epidemiological studies. It will be useful if siting decisions can be coordinated with the epidemiology grantee such that the greatest benefits can be obtained from the site deployments. At the same time, the importance of L2 measurements at rural sites should not be understated – as the benefits of such measurements in developing a better understanding of pollutant (and precursor) transport, chemistry, natural sources, visibility effects and for model development and evaluation may be substantially greater at rural "background" sites than in heavily populated urban centers (where scales of representativeness are inherently less certain).

One of the principles that needs to be incorporated in the network implementation plans is to preserve the integrity of the monitoring system over time. There needs to be an effort to development approaches to assure comparability between old and new monitoring methods. Otherwise, critical trend information will be lost. Thus, it will be typically necessary to operate old and new monitors for an appropriate interval to permit cross-calibration to be performed and maintain continuity of information.

One of the key aspects to eventual success of the new monitoring strategy will be to provide a mechanism for utilizing new monitoring technology as it evolves. The L1 sites provide the opportunity to field test new systems. At this stage, the data quality objectives for the technology could be defined and compared to new system performance. As the technology matures, commercial prototypes can be deployed at a limited number of advanced L2 sites to provide the data needed to develop the correspondence in the values between the old and new

measurement technologies. The Subcommittee supports the data quality objectives process that can lead to carefully defined performance standards for new measurement systems. In the past, design standards have been used to produce a high level of measurement precision. However, they tend to inhibit the development and deployment of new technologies that might provide more complete and useful data. Previously, the CASAC PM Monitoring Subcommittee has commented that it has been overly difficult to qualify continuous $PM_{2.5}$ monitors as equivalent methods. Approaches have now been developed and incorporated into this Strategy document to permit more continuous monitors into the compliance monitoring network. However, it would be better to define performance standards. Previously there were problems with the $PM_{10}$ Federal Reference Method (FRM) monitors because the performance standards were not defined with sufficiently rigid specification to ensure the precision needed for regulatory purposes. In the interim, the data quality objectives (DQO) approach has been defined and thus, in the future, it will be possible to match performance standards with data quality needs. Such an approach will assure the required data quality while providing much more flexibility for commercial instrument developers to produce the best technology for each monitoring need.

Another important aspect of a new national network strategy will be improved quality assurance and operator training. The routine L3 sites will be similar to existing NAMS/SLAMS sites in terms of their complexity, but it is likely that more advanced L3 and many of the L2 sites will include more complex monitoring tools. A well designed national quality assurance approach with extensive training including provision for on-going training for new SLT personnel will be needed. For example, when the $PM_{2.5}$ network was deployed, there was an extensive effort to provide training to the operating personnel. However, over time, there is turnover of operating personnel who have not had direct training. Depending on the quality of the exchange of information between personnel at the SLT level, there can be a degradation of the level of operational capability. Thus, OAQPS must develop regular training programs such as short courses and the opportunity for SLT personnel to utilize such training. This training needs to include the full range of measurements being made within the L2 and L3 levels and not just focus on the criteria pollutants. The comparability of all of the measurements is critical for appropriate regional data analyses.

There are several other aspects of the Strategy that the Subcommittee felt the need to comment on. Currently there is too much emphasis on the measurement of air toxics in the Strategy. It is not clear to the Subcommittee that there needs to be a substantial additional emphasis on HAPs. They need to be included in the comprehensive planning of the redeployed national network, but they do not required the added emphasis that the Strategy currently places on them.

The current data delivery system for the general public, AirNow, was judged to be highly effective and with the incorporation of additional continuous particle monitors in the network, there will be even more effective web access to the data. However, there is inadequate access to the actual near real-time data. The Air Quality System does not provide adequate access to near

real-time air quality monitoring data. These data could be useful to a variety of groups including researchers and public interest groups. The IMPROVE network provides a model system for making their data accessible to any potential users. EPA along with the SLT agencies are expending considerable resources to obtain the air quality monitoring data and these data have not been fully utilized because they are so difficult to obtain. The Subcommittee very strongly recommends that a much better web-based system be established so that all of the data are made available quickly. Making data available rapidly raises the issue of data review and validation. Again there are other models within US agencies in which preliminary data is made available immediately with associated appropriate caveats and then validated data are subsequently provided. Other agencies provide raw data with clear information about the potential for data quality issues and then subsequently provide one or two additional levels of data after various levels of data validation and review. The Strategy should provide convenient mechanisms of of user-feedback, particularly pertaining the data quality.

Certain aspects of "routine data analysis" could also lend themselves to automation. For example: calculations of daily, weekly, monthly, seasonal and annual means, percentiles, exceedance counts, cumulative exposure to date, diurnal averages, day-of-week averages, pollutant ratios, pollution roses, trajectory analyses, etc - with regional & national maps of some of these - could all lend themselves to automation and informative graphic presentation. Since data analysis is often advocated up front and usually neglected later on, it might be useful to develop a "data analysis plan" in advance of implementation of the network, providing some thinking and proposed analysis activities that conducted automatically or periodically with other supplemental data and expert analysts – with what objectives, by whom, and at what cost. There has been a major problem with the PAMS network deployment where there has been a considerable cost to collect data that has largely not been analyzed.

There is no description in the Strategy for a continuing mechanism for scientific input to the implementation of the Strategy and modifications to the Strategy as new information becomes available. The Subcommittee recommends that a standing scientific review committee be associated with the Ambient Air Quality Monitoring Program. The current Subcommittee indicated its willingness to serve in this capacity. The current subcommittee does provide the diversity of expertise needed on such a committee with the possible exception of epidemiology. We recommend that the Subcommittee on the Air Quality Monitoring Strategy be renamed the Subcommittee on Air Quality Monitoring and provide continuing advice to OAQPS and the agency

In summary, the Subcommittee believes that the Strategy is a very important step forward for air quality management. It provides a framework for reshaping the air quality monitoring network to provide more useful data for a variety of purposes. A properly reconfigured network could provide better information for making the critical air quality management decisions that will be needed to protect human health, visibility, ecosystem vitality, crops and managed forests and materials. The Subcommittee looks forward to seeing the key guidance materials that will

be needed to move the implementation process forward as well as reviewing progress as the network is reconfigured in accordance with this multiple objective approach. In addition, the Subcommittee recommends that EPA incorporate the modified approaches resulting from these Subcommittee recommendations into the regulations that are expected at the end of this year. Codification of the recommendations will help to ensure effective implementation. We wish the Agency well in this important endeavor.

Sincerely,

Dr. Philip K. Hopke, Chair
Clean Air Scientific Advisory Committee

Appendix A – Roster of the CASAC NAAMS Subcommittee

# U.S. Environmental Protection Agency
# Science Advisory Board
# Clean Air Scientific Advisory Committee
# National Ambient Air Monitoring Strategy (NAAMS) Subcommittee*

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* Members of this SAB Panel consist of:

a. SAB Members: Experts appointed by the Administrator to serve on one of the SAB Standing Committees.

b. SAB Consultants: Experts appointed by the SAB Staff Director to a one-year term to serve on ad hoc Panels formed to address a particular issue.

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